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**Design Lab: Comparing biodiversity in areas with varying soil pH**

Aim: To investigate whether soil pH affects the biodiversity of an area.

Research Question: Does the pH of soil affect the biodiversity of an area?

Null Hypothesis: There is no correlation between the pH of the soil and the biodiversity of the area in which the soil comes from.

Hypothesis: The acidity (or alkalinity) affects the biodiversity of living organisms in an ecosystem. The higher the alkalinity, the less diversely rich an ecosystem is. This is thought because alkalinity affects the soil fertility and toxicity by determining which elements are available for absorption from plants.

Investigation: 200 leaves will be collected in two separate areas. 5 samples of soil will be taken from each area to test the pH of the soil. This will allow for a Simpson’s Diversity Index to be used with the leaves collected, and this value will be compared to the average pH of soil of each area.

Materials:

* pH probe and reader
* 10 cups to put samples of soil in
* A hand shovel
* 2 bags
* Measuring tape

Variables:

**Independent:** the average pH of the soil in the region

**Dependent:** the biodiversity of the area

**Controlled:**

* The time of day was constant as the lab was performed on the same day within the same hour. This could affect the qualitative observations of organisms under the soil. It is also important to perform the lab on the same day at roughly the same time because weather conditions such as precipitation, wind and light may change during the day and alter the pH of the soil.
* Temperature in °C remained constant as the lab was performed on the same day. This could affect the qualitative observations of organisms under the soil.
* Shaded: both regions were shaded regions. This is important to remain constant because perhaps biodiversity is affected by the amount of light the organisms are exposed to. The light intensity could also affect the pH in the soil.
* Time of year remained constant because the lab was performed on the same day. The time of year could affect the number of leaves picked up from the ground, as well as the types of organisms that are counted in the index. The time of year could also affect the pH of the soil due to weather and temperature, so it was important to perform the lab at the same time of year.
* One person picked up leaves which is important because this way the individual is more likely to follow their own pattern. Had a different person collected the leaves in the second region, perhaps a different method of random collection would have been used, perhaps altering the data.
* One person collected the soil which is important because the individual collection the soil could use the same random technique in both areas. The same individual should also be taking the qualitative data of the soil in both reasons, to be able to visually compare the two regions.
* The size of the quadrat (10m2) was constant for both areas, in order to guarantee that a diversity of leaves was being collected from an equal area for accurate comparison

Procedure:

1. An ecosystem was selected, and an area of 10m² was measured and indicated
2. 200 leaves from within the whole area of 10m² were collected randomly and put into bags to be counted later
3. The leaves were used to find the area’s biodiversity, using Simpson’s biodiversity index
4. Approximately 5 samples of 1 cup of soil were dug up from within the 10m² area
5. Qualitative observations were made from observing the soil and its contents
6. Using a pH probe, the pH of the soil was taken by inserting the probe into the dug up soil sample
7. The pH was recorded
8. Steps 1 to 8 were repeated in another region

Data Collection and Processing

**Table Demonstrating pH of Soil Collected in Two Regions**

|  |  |  |
| --- | --- | --- |
|  | **Branksome Woodlot** | **Forest Area** |
| **Number of Sample of Soil** | **pH of Soil ±.001** | |
| Sample 1 | 6.046 | 6.017 |
| Sample 2 | 6.093 | 5.620 |
| Sample 3 | 6.284 | 6.176 |
| Sample 4 | 6.274 | 5.998 |
| Sample 5 | 6.017 | 5.833 |
| **Mean pH of soil** | **6.142** | **5.922** |
| **Standard Deviation** | **0.113866** | **0.211075** |

***Table 1: pH of soil***

**Table Demonstrating the Qualitative Observations of the Soil in the Woodlot and Forested Area**

|  |  |
| --- | --- |
| **Qualitative Observations of Soil and Organisms** | |
| **Branksome Woodlot** | **Forest Area** |
| * Many worms and other small organisms visible in the soil * Feels very moist * Soil does not appear to have been affected by humans- little human traffic | * Soil feels less moist * More rocks visible in the soil * Fewer organisms such as worms visible in the soil * Does not appear to have been affected by humans- little human traffic |

***Table 2: Qualitative Observations***

***Figure 1: Graph representing mean pH values from area 1- Branksome Woodlot, and area 2-Forested Area, including standard deviation values***

T Test for the pH Values of Soil Taken from Area 1- Branksome Woodlot and Area 2- Forested Area

T value= 10638.256

P= 8.836x10-9

**Table Demonstrating the Variety of Different Leaf Species Collected in the Woodlot and the Number of Each Species Found When 200 Leaves Were Randomly Selected**

|  |  |
| --- | --- |
| **Number of Different Species Found** | **Number of Leaves of that Specie Collected** |
| 1 | 44 |
| 2 | 2 |
| 3 | 3 |
| 4 | 5 |
| 5 | 23 |
| 6 | 21 |
| 7 | 2 |
| 8 | 40 |
| 9 | 43 |
| 10 | 4 |
| 11 | 6 |
| 12 | 7 |
| **Qualitative Data**   * Area completely covered in leaves, mostly brown, yellow and red * Many cut down, dead trees * All trees are very tall with varying sizes of trunks- mostly very wide trunks * Not a very busy area with traffic- little human impact | |

***Table 3: Leaves collected in area 1- the Woodlot***

Calculations to find the Woodlot’s Biodiversity with Simpson’s Diversity Index

D=N(N-1)

Σn(n-1)

=200(200-1)

44(44-1)+2(2-1)+3(3-1)+5(5-1)+7(7-1)+23(23-1)+21(21-1)+2(2-1)+40(40-1)+43(43-1)+4(4-1)+6(6-1)

=39800

6293

~6.32

**Table Demonstrating the Variety of Different Leaf Species Collected in the Forested Area and the Number of Each Species Found When 200 Leaves Were Randomly Selected**

|  |  |
| --- | --- |
| **Number of Different Species Found** | **Number of Leaves of that Specie Collected** |
| 1 | 48 |
| 2 | 51 |
| 3 | 16 |
| 4 | 17 |
| 5 | 29 |
| 6 | 32 |
| 7 | 7 |
| **Qualitative Observations**   * More trees that haven’t lost leaves yet- still green * Very steep incline in the area * Perhaps a little bit more light shining through the trees * Trees are not as tall and trunks are not as wide as Woodlot * Not a very busy area- little human traffic | |

***Table 4: Leaves collected in area 2- the Forested Area***

Calculations to find the Forested Area’s Biodiversity with Simpson’s Diversity Index

D=N(N-1)

Σn(n-1)

=200(200-1)

48(48-1)+51(51-1)+16(16-1)+17(17-1)+29(29-1)+32(32-1)+7(7-1)

=39800

7164

~5.55

***Figure 2: Graph representing the biodiversity in Area 1- the Branksome Woodlot, and Area 2- the Forested area, using data collected from Tables 3 and 4, and the Simpson’s Diversity Index calculations***

T Test for the Diversity Indices of Area 1- Branksome Woodlot vs Area 2- Forested Area

T value= 1265

P= 5.03 x 10-4

Conclusion and Evaluation

The data shown above indicates that the Branksome Woodlot has a higher soil pH (closer to pH 7; neutral) and a higher diversity index than the forested area near by. The hypothesis states that an area with a soil pH closer to 7 (neutral) will have a greater diversity because the acidity in the soil affects the fertility and ability for organisms to grow and thrive.[[1]](#footnote-1) The correlation between the higher biodiversity in the Woodlot and the area’s more neutral pH means that the hypothesis is supported in that the more neutral pH allows for a greater diversity of plants to thrive.

The t tests from both parts of the lab however, show that there is no significant difference between the two values being compared; pH values Area 1 vs. Area 2, and Diversity Index Area 1 vs. Area 2. It is also indicated in Figure 1 that the Standard Deviation values for Area 1 and Area 2 overlap, meaning that there is lots of data shared, and the results are not likely significantly different.

The data supports the hypothesis however, because the independent variables, pH values, do not differ very much from each other and as a result, the diversity indices of the areas do not significantly differ either. A correlation is shown though, because this slight difference in both tests indicates that biodiversity does depend on the pH. With more varying data for the pH values, the correlation likely would have been much more significant.

The apparatus used in this lab held uncertainty, hindering the amount of comparable data. The pH probe used was very uncertain because it never held a constant number; it was always changing slightly. This demonstrated that the values the probe provided were not completely accurate. To fix this uncertainty, three trials for a pH value could have been taken for *each* sample of soil. From the three trials, an average could be produced for each sample. This would involve 2 extra trials per sample of soil, but it would have made the data much more reliable and comparable.

The areas chosen to study were not very well chosen because they were so close together. Area 1-Woodlot had only a slightly more neutral pH value of soil than Area 2-forested area. This means that there was no significant difference, making it difficult to compare the correlation between biodiversity and pH. What would have made the data more comparable would be to have chosen two areas that were very far apart from each other. The areas would of course have to hold many of the same characteristics such as light intensity, temperature and size of the quadrat, but collecting data from far separated areas may have provided more significantly different results for pH value of soil.

The time that this lab was taken was not the most efficient time of year. Because the lab was done in the fall, almost all of the leaves had fallen to the ground. Literally, the whole ground in both Areas 1 and 2 were covered in leaves. This left quite a large uncertainty as to whether a random sample of leaves was being chosen. It is very possible that only the leaves lying on the top of the bed of leaves were chosen, or different species of leaves were deliberately chosen for a Biodiversity test. The lab should have been performed in the summer, when few leaves were on the ground, and instead the number of trees and plants should have been counted (of course in a larger area). This would have provided much more certain data which would be more comparable with the pH values.

1. "Soil pH." *Soil Science Education Home Page*. Web. 18 Nov. 2009. http://soil.gsfc.nasa.gov/soil\_pH/plant\_pH.htm>. [↑](#footnote-ref-1)